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East Europe Report

SCIENTIFIC AFFAIRS

No. 718

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CONTENTS

MICROPROCESSOR CONTROL PC 1520 M FOR INDUSTRIAL ROBOTS

Description of Control System

East Berlin RADIO FERNSEHEN ELEKTRONIK in German Vol 30 No 7, Jul 81 pp 424-426

[Article by Hans Georg Wanke, engineer, VEB Automobile Construction Scientific-Technical Center: "Microprocessor Control PC 1520 M for Industrial Robots"]

[Text] Presently there are no low-priced solutions in contemporary control technology available for small-scale control tasks in the manufacture of rationalization devices. This article describes an application for the microcomputer system K 1520 for controlling simple industrial robots and special machines. Two connection controls for digital process input and output are presented.

With the creation of a central unit for the planning, design and manufacture of rationalization systems for the Industrial Association for Motor Vehicle Construction in the automobile construction scientific-technical center in Karl-Marx Stadt arose the necessity of developing a special control technology. Work is presently being done on the development, testing and preparation for manufacture of a microprocessor control for simple industrial robots and special machines. This control with the designation PC 1520 M is an application of the microcomputer system K 1520 of the VEB Kombinat Robotron, which is made up of the input and output components multiplex input control (MES), input and output control (EAS) and PMS [expansion unknown], as well as display and operating keys.

Control Assembly

Card components with the dimensions 215 mm by 170 mm have been accommodated into the container system of the microcomputer K 1520, and are linked together through a printed reverse wiring. The plug coupling on the knob side of the card components MES, EAS and PMS serves the connection on the process side. The modular control assembly permits the use of the MES card component, with a maximum of eight EAS, two to three PMS and additional components of the K 1520 system (for example, connection controls and memory enlargement).

Power supply modules from the VEB Robotron provide the required working voltages of 5V, 12V and -5V. These modules are accommodated in a separate power supply cassette.

Figure 1 shows the configuration for the control pattern of loading robot.

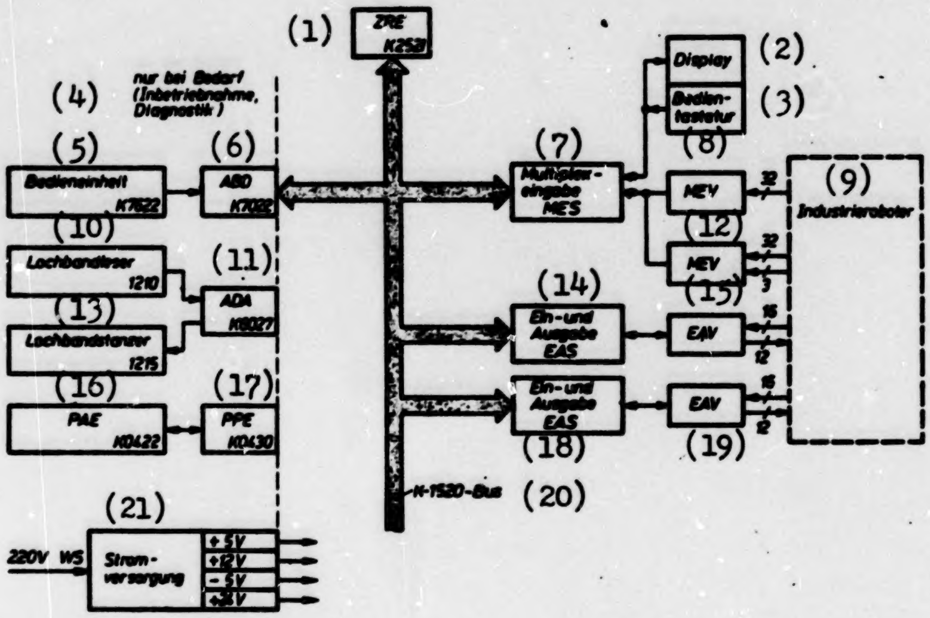

Figure 1. Component View PC 1520 M

Key:

1. Central arithmetic unit
2. Display
3. Operating keys
4. Only when needed (starting, diagnostics)
5. Operating unit
6. Connection control ABD [operator console]
7. Multiplex input
8. Multiplex input distributor
9. Industrial robot
10. Punched Tape Reader
11. Connection control ADA [SIF 1000 units]
12. Multiplex input distributor
13. Perforated tape puncher
14. Input and output
15. Input and output distributor
16. Program Supplement PAE [EPROM recorder]
17. Program Supplement PPE [EPROM Programming Device]
18. Input and output
19. Input and output distributor
20. K 1520 bus
21. Power supply

Central Calculating Unit (Robotron K 2521)

This card component is a single-board calculator with the functional groups

--Microprocessor U 880
--Memory: 1K bit RAM U 202
          3K bit EPROM U 555
--Parallel interface with U 855
--Meter, timer with U 857

--Cadence generator for the system cadence of 2.5 megahertz
--Initial erasing
--Bus propeller for the system bus K 1520

Multiplex Input Control MES

The card component MES (Figure 2) employs parallel interface and meter of the card component central arithmetic unit over the coupling bus. It is of central importance within the control PC 1520 M and includes the functions

--Display connection
seven-segment LED's with a maximum of ten positions or single LED's for providing readings in the multiplex operation (software controlled)
--Multiplex input
32 bits (8X4 bits), optimum coupling, 24V, 15mA direct current, 32 bits (8X4 bits), TTL level [Transistor-Transistor Logic]
--Interrupt input
3 bits, optimum coupling, 24V, 15mA direct current
--Memory enlargement
1K bits RAM U 202
3 plug sockets for a maximum of 3K bits-EPROM U 255
--Cycle monitoring
--Monitoring of working voltage
--Diagnostics reading and operating keys

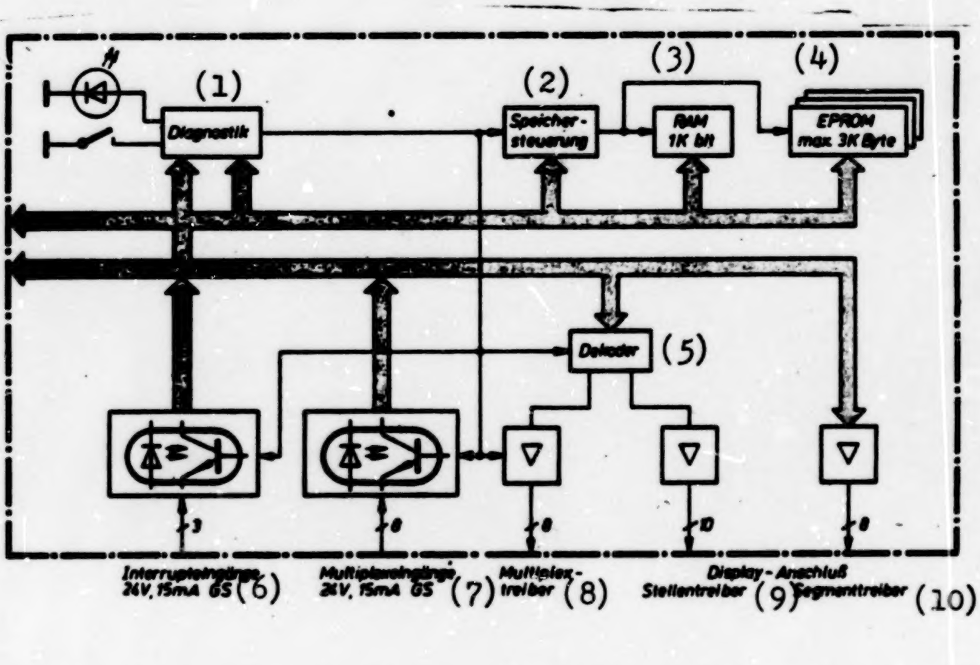

Figure 2. Basic Circuit Diagram for Multiplex Input Control MES

[Key on following page]

Key:

1. Diagnostics
2. Memory control
3. RAM 1K bits
4. EPROM
   Maximum 3K bits
5. Decoder
6. Interrupt input
   24V, 15 mA direct current
7. Multiplex input
   24V, 15 mA direct current
8. Multiplex propeller
9. Display connection position propeller
10. Display connection segment propeller

Input and Output Control EAS

The output relays are activated and the input with optimum coupling is operated over the parallel interface U 855. The process-side connection over a 58-pole plug coupling which serves the connection for the input-output distributor, effects the output for 12 bits, 24V, 2 A direct current, and the input for 16 bits, 24V, 15 mA direct current. The logical states of the input and output are indicated on the front side by LED's. Figure 3 shows the basic circuit diagram of the card component EAS.

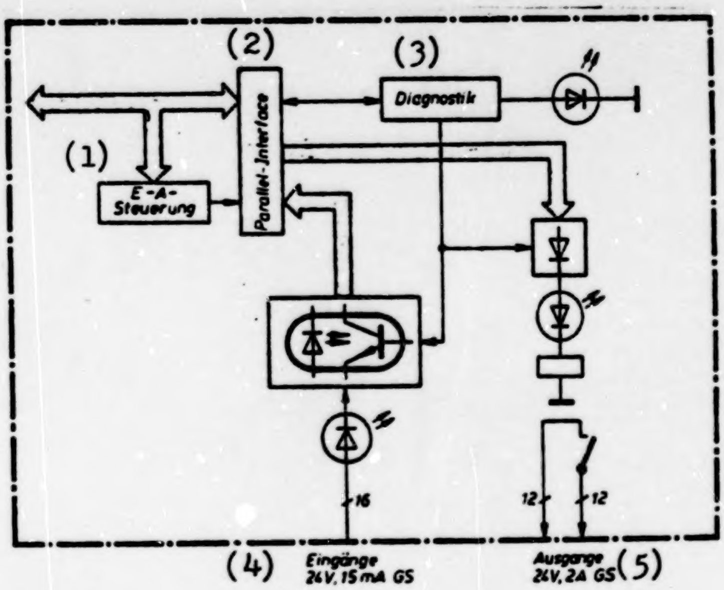

Figure 3. Basic Circuit Diagram for the Input and Output Control EAS

Key:

1. Input and output control
2. Parallel interface
3. Diagnostics
4. Input
   24V, 15 mA direct current
5. Output
   24V, 2A direct current

Distribution Frame

The distribution conductor plates provide for the direct connection of the site members (for example: magnet valves, contactors), terminal switches, initiators, etc., over flat plug couplings. The conductor plates have a format of 415 mm by 130 mm, and can be set over spacer bolts. The distributor can be mounted either in the control container, or preferably, in the immediate proximity of the machine.

Additional Components

The display and operating keys, which are joined to the computer bus over the card component MES, provide for performing the operating functions. The card component positioning and measuring control MES serves to control two hydraulically or pneumatically driven axles.

The K 1520-bus is available for purposes of beginning operation and testing. As was shown in Figure 1, the following can be selectively plugged in:

--Operating unit (Robotron K 7622) with connection control ABD (Robotron K 7028)
--Perforated tape reader 1210, perforated tape puncher 1215 with connection control ADA (Robotron K 6022)
--Program supplement PPE/PAE (Robotron K 0420/0422) for programming EPROM's

Function

Software

The programmable control PC 1520 M is mainly used to solve nonnumerical control tasks. The control problem, which is taken down in the form of logical associations (Boolean equations) and stored on EPROM's, is processed through the microcomputer with an interpretation program. Here the Boolean equations represent the calculating specifications, whereas the logical variables to be processed are input, output, auxiliary storage, etc.

The interpretation program works cyclically, and computes the output variables equation for equation dependent upon the input variables. Special functions, such as multiple-axle positioning procedures, where time is critical, are programmed directly into the assembler language of the microcomputer.

The operating system of the microcomputer organizes the cyclical flow, input and output operations, interrupt processing and the completion of background programs.

Programming

The programming of Boolean equations and the storage on EPROM's can occur externally with the help of formative systems or economic calculating units and other PROM programming equipment, or (preferably) at the time of control operations. In the latter case the equations are input at the job site using the operating keys and shown on the display.

In the case of program changes an EPROM is reprogrammed with the program supplement and exchanged with the old.

It is advisable in the case of extensive start-up work and testing to use RAM's (for example, card component OPS [Main Memory 4 K-byte RAM] K 3520 or OPS K 3521) instead of EPROM's.

Diagnostics

A series of diagnostic measures is foreseen for the PC 1520 M in order to further increase the reliability and to lower the costs of error search. For the present they are limited to internal diagnosis, that is, diagnosis of functional control elements. A later extention of diagnostics to include the special machinery or industrial robot is possible. A first step in this direction is an error indication on the display, to be programmed through Boolean equations.

Internal diagnostics deals with components and elements in four different stages:

1. Basic diagnostics, after establishing the working voltage

2. On-line diagnostics, cyclical monitoring, voltage monitoring, LED readings for input and output

3. Off-line diagnostics, activation through operations

4. Diagnostics by external means.

The first three diagnostic stages are realized with a minimum of outlay for hardware through programs which are constantly at hand. More extensive tests (for example, full control examination) require external storage.

Configuration of K 1520 Described

East Berlin NTB--JOURNAL OF INFORMATION PROCESSING in English Vol 24 No 6, Nov-Dec 80 pp 177-179

[Article by B. Bader, engineer, Zella-Mehlis: "Remarks on the Configuration of Microcomputers Robotron K 1520"]

[Text] **1. Modular Concept**

The microcomputer system robotron K 1520 is composed of the microcomputer K 1520 and the microcomputer software K 1520. The following article is concerned with the set-up of the hardware of the microcomputer K 1520.

The logic-function units of the microcomputer K 1520 are accommodated on separate plug-in units, and they are connected by the system bus. Plug-in inserts are used to accommodate the plug-in units. The individual components can be assembled into microcomputers of any configuration to match the application in hand. The advantageous set-up of the central arithmetic unit means that one plug-in unit is already sufficient where capacity demands are low. The system bus is not required for such a configuration.

The plug-in units are equipped with direct or indirect plug-in bus connectors.

2. Return Wiring and Plug-in Inserts

The plug-in units are taken up by the plug-in inserts. Both sets of entire plug-in units as well as individual units can be combined in any manner desired and housed in enclosures of the user, e.g. in EGS assembler inserts of 480 mm width.

The plug-in connector terminals of the return wiring of the coupling bus, and also of the system bus, are provided with long wire-wrap pins. This means that any connectors on the return wiring circuit boards can be additionally wire-wrapped.

For the system bus (lower return wiring circuit board with the plug connectors X_1) there is usually no need for extra wrapping because all signal connections are interlinked by printed conductors. The coupling bus, on the other hand, has printed conductors only for the ground and power supply terminals. All other connections have to be wound. Thus, the coupling bus is suited for the connections of the terminals of the user's own plug-in units. In the event that the user's own enclosures are employed, the user himself will have to complete the return wiring. The return wiring of the plug-in inserts can also be integrated in these enclosures. Two plug-in inserts can be screwed together. The bus lines can be conducted on the return-wiring side by wrap connections between the neighbouring edge plug connectors. In this manner insert enclosures can be produced to accommodate 16, 22, a.s.o. plug-in units. The return wiring of the system bus can be extended up to a length of 800 mm.

3. Priority Allocation

In principle, every plug-in unit can be plugged into any point in the plug-in insert. In practice, however, it is the distance with which the plug-in unit with its peripheral circuitry (connection control, bus amplifier, etc.) is plugged from the central arithmetic unit that determines the priorities of the plug-in concerned in the treatment of interrupt requests and in the presence of requests for bus control. The smaller the distance to the central arithmetic unit, the higher the order of priority. Plug-in units for storage are not considered in this context. Storage places that are not occupied are either provided with bridges (IEI – IEO and BAI – BAO) in the return wiring, or the plug-in units are all placed in a flush arrangement.

4. Bus Extensions

By interposing a bus amplifier the system bus can be extended load-wise by a maximum of 2.5 m. The line K 0521 (2 pieces) is used as extenison cable. The adapter plug-in unit K 0522 is required for the connection of a new plug-in insert.

Provided that certain conditions are observed, a star-shaped or serial system can be set up with several plug-in inserts. The star-shaped system contains several bus amplifiers in one plug-in insert. The serial system allocates a bus amplifier to each plug-in insert.

5. Semi-conductor Store

A 64K-byte store can be addressed with the address bus. Storage can consist of working stores, combined working and read-only

Table 1. System components of the microcomputer robotron K 1520
Code K XXXX.X0 means indirect bus plug connector
Code K XXXX.X5 means direct bus plug connector

Designation	Abbrev.	Cipher	No of plug-in units	Remarks
Central processing unit	ZRE	K 2521.00	1	Clock generator, real-time clock, 1K-byte RAM, 3K-byte EPROM, parallel input and output
Central processing unit	ZRE	K 2521.05	1	
Central processing unit	ZRE	K 2522.00	1	Real-time clock, 1K-byte RAM, 3K-byte EPROM, parallel input and output
Central processing unit	ZRE	K 2522.05	1	
Central processing unit	ZRE	K 2523.00	1	Clock generator, 1K-byte RAM, 3K-byte EPROM, parallel input and output
Central processing unit	ZRE	K 2523.05	1	
Central processing unit	ZRE	K 2524.00	1	1K-byte RAM, 3K-byte EPROM, parallel input and output
Central processing unit	ZRE	K 2524.05	1	
Central processing unit	ZRE	K 2525.00	1	Clock generator, real-time clock, 8K-byte EPROM
Central processing unit	ZRE	K 2525.05	1	
Main memory 4K-byte RAM	OPS	K 3520.00	1	n-MOS
Main memory 4K-byte RAM	OPS	K 3520.05	1	n-MOS
Main memory 4K-byte RAM	OPS	K 3521.00	1	CMOS
Main memory 4K-byte RAM	OPS	K 3521.05	1	CMOS
Main memory 16K-byte RAM	OPS	K 3525.00	1	dynamic RAM
Main memory 16K-byte RAM	OPS	K 3525.05	1	dynamic RAM
Main ROM 6K-byte EPROM, 2K-byte RAM	OPS	K 3620.00	1	n-MOS RAM
Main ROM 6K-byte EPROM, 2K-byte RAM	OPS	K 3620.05	1	n-MOS RAM
Main ROM 6K-byte EPROM, 2K-byte RAM	OPS	K 3621.00	1	CMOS RAM
Main ROM 6K-byte EPROM, 2K-byte RAM	OPS	K 3621.05	1	CMOS RAM
ROM 16K-byte EPROM	PFS	K 3820.00	1	
ROM 16K-byte EPROM	PFS	K 3820.05	1	
Bus amplifier	BVE	K 4120.00	1	
Bus amplifier	BVE	K 4120.05	1	

Connector control floppy disk storage	AFS	K 5121.00	1	1 to 4 floppy disk units MF 3200
Connector control floppy disk storage	AFS	K 5121.05	1	
Connector control SIF 1000 units	ADA	K 6022.00	1	robotron 1210, 1215, 1156 and 4000 (console printer)
Connector control SIF 1000 units	ADA	K 6022.05	1	
Connector control video display screen	ABS	K 7023.00	1	Video display assembly K 7221 (2 brightness stages)
Connector control video display screen	ABS	K 7028.05	1	
Connector control punched tape station	ALB	K 6025.00	1	Punched tape station K 6200
Connector control punched tape station	ALB	K 6025.05	1	
Connector control cassette tape unit	AKB	K 5070.00	1	1 or 2 cassette tape units K 5200 of 1 cassette tape unit K 5221
Connector control cassette tape unit	AKB	K 5070.05	1	
Connector control operator console	ABD	K 7022.00	1	Operator console K 7622
Connector control operator console	ABD	K 7022.05	1	
Connector control V.24 interface	ASV	K 8021.00	1	2 channels V.24
Connector control V.24 interface	ASV	K 8021.05	1	
Operator console	BDE	K 7622.00		Without housing for building in
Operator console	BDE	K 7622.01		With housing as table-top unit
EPROM programming device	PPE	K 0420.00	1	Connection of EPROM recorder for EPROM programming
EPROM programming device	PPE	K 0420.05	1	
EPROM recorder	PAE	K 0422		Table-top unit
EPROM erasing unit	PLG	K 0421		Table-top unit
Plug-in units insert	STS	K 0120		5 plug-in places
Plug-in units insert	STS	K 0121		11 plug-in places
Connecting lead	LTG	K 0521.01		For bus amplifier: 2.5 m; 2 leads
Connecting lead	LTG	K 0521.02		For bus amplifier: 1.2 m; 2 leads
Connecting lead	LTG	K 0521.03		For bus amplifier: 0.6 m; 2 leads
Connecting lead adapter	VLA	K 0522.00	1	For connecting lead
Connecting lead adapter	VLA	K 0522.05	1	

Table 2. Power requirements of the plug-in units in mA

Ab-brev.	Cipher	5P	5N	5PG	12P	12NR
ZRE	K 2521.00 05	1300	70	240 (150)	120	—
ZRE	K 2522.00 05	1450	70	240 (150)	120	—
ZRE	K 2523.00 05	1450	70	240 (150)	120	—
ZRE	K 2524.00 05	1400	70	240 (150)	120	—
ZRE	K 2525.00 05	1000	200	—	300	—
OPS	K 3520.00/05	600	—	1100 (600)	—	—
OPS	K 3521.00/05	600	—	40	—	10
OPS	K 3525.00 05	600	0,03	—	550	—
OFS	K 3620.00 05	700	200	500 (300)	300	—
OFS	K 3621.00 05	700	200	40	300	10
PFS	K 3820.00/05	900	500	—	900	—
BVE	K 4120.00 05	750	—	—	—	—
AFS	K 5121.00 05	2500	20	—	—	—
ADA	K 6022.00/05	900	—	—	100	—
ABS	K 7023.00 01	2800	100	—	150	—
ALB	K 6025.00 05	1000	—	—	—	—
AKB	K 5020.00 05	1600	—	—	—	—
ABD	K 7022.00/05	1200	—	—	—	—
ASV	K 8021.00 05	800	—	—	60	140
PPE	K 0420.00 05	1100	50	—	200	—

stores, and of read-only stores. The number of address bits can be extended by user-specific control of the signals /MEMDI 1 and /MEMDI 2 of the coupling bus. A storage volume of 128K-bytes can be addressed.

6. Connections for Input and Output

The bits AB∅ ... AB7 of the address bus apply with /IORQ as device address for input and output. This means that 256 addresses can be implemented for input and output.

The address areas ∅∅ ... $7F_H$ and 9∅ ... FF_H are available for device controllers. The in-between address area is allocated to the peripheral circuits of the central arithmetic unit.

7. Multi-computer Combinations

Several computer configurations of the type K 1520 are coupled by specific connections of the coupling bus (generated by the parallel input/output circuit of the central arithmetic units K 2521 ... K 2524). The connecting length must not exceed 480 mm, otherwise extra measures become necessary, e.g. interposing of amplifiers.

Up to four computer configurations can be combined. Each configuration can consist of a complete microcomputer K 1520 with storage, connection controls, etc.

8. Power Supply

The power supply modules of the microcomputer system K 1510 can be employed for the power supply of the microcomputer K 1520. Remarks on the configuration are given in the tables 2 and 3 (3).

The voltages 5P and 5PG can be fed from a common source. The 5PG voltage is the supply voltage for the RAM storage circuits. To ensure that the stored data is not lost in the event of a mains failure, 5PG must be larger than 2V. Small accumulators on the plug-in unit retain the data with CMOS-RAM.

$$
\begin{aligned}
5\,P &= +\ 5\,V \pm 5\,\% \\
5\,N &= -\ 5\,V \pm 5\,\% \\
5\,PG &= +\ 5\,V \pm 5\,\% \\
12\,P &= +\ 12\,V \pm 5\,\% \\
12\,NR &= \ 26\,V \pm 12\,\%;\ -20\,\%
\end{aligned}
$$

The power requirements, specified next to the power requirement values of 5 PG in brackets, applied to the idling current > 2 V.

9. Cables and Connection Lines

The microcomputer K 1520 has no cables of its own for the connection of peripheral units. The corresponding cables from the assortment of the microcomputer system K 1510 can be used for this purpose (3). *NTB 2738*

References

(1) Betriebsdokumentation Mikrorechner K 1520
1.11.004 650.0/97

B. Bader: Mikrorechnersystem K 1520. radio · fernsehen · elektronik 28 (1979), No 10, pp. 616 to 620.

(3) R. Günther: Remarks on the Configuration of Microcomputers K 1510. NTB 24 (1980), No 1, pp. 24 to 27.

Table 3. Power requirements of the units

Designation	Cipher	u (V)	f (Hz)	I (A)
Operator console	K 7622	220 + 10 %; − 15 %	50 ± 2	0.13
EPROM erasing unit	K 0421	220 + 10 %; − 15 %	50 ± 2	0.12

CSO: 2302/7

DETERMINATION OF SERUM ALKALINE PHOSPHATASE, CA AND INORGANIC P VALUES IN THE BLOOD SAMPLES OF PHEASANT EMBRYOS TREATED WITH WOFATOX 50 EC, METHYLPARATHION 18 WP AND CAPTAN

Budapest MAGYAR ALLATORVOSOK LAPJA in Hungarian Vol 36 No 6, Jun 81 pp 426-428
manuscript received 24 Nov 80

[Abstract] In Hungary, thiophosphoric acid derivatives with methylparathion as active ingredient are currently used as insecticides while earlier, the use of ethylparathion was also permitted. Teratological studies were conducted using two compounds of different composition and concentration but both containing methylparathion: Wofatox 50 EC and methylparathion 18 WP. The phtlalimide-type Captan techn. 92 percent was used as positive control. The SAP, Ca and inorganic P values were determined and were compared with earlier data using ethylparathion insecticides. On the 12th day of incubation, a 0.1 ml aqueous suspension or emulsion containing different concentrations of the test chemicals was injected into the air sack of each egg. Blood was withdrawn from the umbilical artery by means of heparinized glass capillaries on the 23rd day of incubation. The serial measurements were automatized and ultramicro techniques were used. An optimized kinetic method was used to determine the SAP activity. Ca and P were determined by colorimetry. The results show that none of the compounds caused a unidirectional, dose-dependent change in the biochemcial values measured, in comparison with the controls which had been injected with distilled water. In contrast, teratological studies using the same pesticides showed a significant, concentration-dependent increase in the number of embryos with bone deformities, similarly to earlier studies using Parathion 20 WP. It is probable that the significant pathological and pathohistological changes are related to changes in other biochemical factors (hormones, vitamins, emzymes, etc.). References 16: 7 Hungarian, 1 Czechoslovakian, 8 Western.

2473
CSO: 2502/93

BIOLOGICAL AND PHYSICO-CHEMICAL PROPERTIES OF THE HUNGARIAN B8/78 STRAIN OF EDS VIRUS

Budapest MAGYAR ALLATORVOSOK LAPJA in Hungarian Vol 36 No 6, Jun 81 pp 420-425 manuscript received 8 Oct 80

ZSAK, Laszlo, Dr, KISARY, Janos, Dr, candidate of veterinary sciences; Hungarian Academy of Sciences, Veterinary Medical Research Institute

[Abstract] The antigenic structure of the domestic B8/78 strain of EDS (egg drop syndrome) virus is identical with strain 127 and its morphological properties are characteristic of the adenovirus. An attempt is made to resolve some contradictions present in the literature with respect to the physical and biological properties of EDS virus, strain 127. The B8/78 strain was grown in the allantoic cavity of embryonated duck eggs (AE virus) and in chick embryo liver cell cultures (Se virus). They were compared based on CsCl gradient centrifugation. The AE virus particles separated into two peaks with buoyant densities of 1.36 and 1.31 g/ml while the buoyant densities of the SE viral populations were 1.33 and 1.31 g/ml. Two methods were used for purification. After preliminary purification without ultracentrifugation and ultrasound treatment, followed by gradient centrifugation (B), the heavy particles preserved their infectiousness and produced hemagglutination while the same virious lost their hemagglutinating activity after ultracentrifugation and ultrasound treatment. The light virious produced hemagglutination irrespective of the method of purification but were not infectious. The virus could be grown equally well in cell cultures of both chicken and goose origin. Viral growth was signified by intranuclear inclusion bodies and by IF positivity in the afflicted cells. Heat and pH sensitivity was comparable to that reported for the FAV 1 (CELO) virus. On digesting the DNA of the virus with R. EcoRI restriction endonuclease according to Sumegi, it separated into four fragments. The molecular mass of the undigested DNA was 23.7×10^6 daltons. There was no difference in the protein composition of AE and SE virus strains upon polyacrylamide gel electrophoresis. The protein structure of the heavy virions is characteristic of adenoviruses. Of the 15 protein fractions found, a polypeptide with a molecular mass of 20 thousand was missing from the light virions of both viruses. References 11: 1 Hungarian, 10 Western

2473
CSO: 2502/93

IMMUNIZATION ATTEMPTS AGAINST FOWL CHOLERA

Budapest MAGYAR ALLATORVOSOK LAPJA in Hungarian, Vol 36 No 6, Jun 81 pp 415-418
manuscript received 18 Nov 80

MOLNAR, Imre, Dr; Phylaxia Vaccine and Nutriment Producing Enterprise

[Abstract] It was attempted to produce a fowl cholera vaccine in which the antigenic structure--with special emphasis on the protein molecule--is not damaged and the protective antigen is present in sufficient concentration. Using ethanol and methanol to treat fermented cultures of virulent P. multocida strains under controlled conditions, a fowl cholera vaccine was obtained which produces satisfactory immunization. Producing reversible denaturation, the two alcohols used do not damage the protein component of the antigenic structure during inactivation thus retaining its biological activity. Collected over several years from acute fowl cholera infections, numerous virus strains from various parts of the country were tested for their virulence in hens. Only the most virulent strains were used for cross immunization experiments. One of the strains (BK_1) was found to yield a vaccine which produced 60-100 percent immunity against all of the strains obtained from 98 foci of infection including its own, under laboratory conditions. The results show that, in Hungary, there is no immunobiological difference among the virus strains producing acute fowl cholera. However, there was great variation in virulence among the strains isolated in the course of individual epidemics.
References t: 3 Hungarian, 2 Western

2473
CSO: 2502/93

VIRULENCE OF STRAINS OF THE AUJESZKY'S DISEASE VIRUS ISOLATED FROM SWINE

Budapest MAGYAR ALLATORVOSOK LAPJA in Hungarian Vol 36 No 6, Jun 81 pp 394-]97
manuscript received 17 Mar 81

MOCSARI, Endre, Dr, candidate of verterinary sciences; National Animal Health Institute

[Abstract] Serological screening tests revealed the occasional presence of latent infection in large-scale swine stocks. The study was carried out to elucidate the possible role of the K/61 virus, present in the live-virus vaccine used in Hungary, or of some other, less virulent virus strain in these infections. Isolated from swine cadavers received by the institute, the virulence of 33 strains of Aujeszky's disease virus was tested on 3-4 week mice after intracerebral infection with 100 $TCID_{50}$ doses of the virus. The mice were examined at 6-hour intervals for 7 days. Average time of death ($\overline{DT}$), intracerebral pathogenicity index (ICPI) and the occurrence of pruritus were used as measures. Virus reisolation from the mouse brains was carried out in every case, using immunofluorescence for identification. The cytopathogenic effect of the original and reisolated strains was compared in Vero, IB-RS-2 and secondary swine kidney cell cultures with special attention to syncytium formation. The heat and trypsin sensitivity of 11 strains was also determined. The properties of the K/61 vaccine virus were used for comparison. Based on their ICPI and $\overline{DT}$ values, all strains were virulent. The averages were $\overline{DT}$: 58.29 (48-81) hours and ICPI: 1.41 (1.26-1.62) and they differed significantly (p 0.05) from the K/61 values. Pruritus was present in 69.7 percent of the cases but in none of the mice inoculated with the K/61 virus vaccine. Syncytia were formed by every isolated virus strain in all three types of cell cultures while no such formation occurred during growth of the K/61 strain. The heat and trypsin tests were unsuitable for characterizing the virulence of virus strains.
References 10: 3 Hungarian, 1 Russian, 6 Western

2473
CSO: 2502/93

IMMUNGENIC EFFECT OF SIMULTANEOUSLY ADMINISTERED VACCINES AGAINST VIRAL DIARRHEA (VD) AND CONTAGIOUS HOOF-AND-MOUTH DISEASE (HMD)

Budapest MAGYAR ALLATORVOSOK LAPJA in Hungarian Vol 36 No 6, Jun 81 pp 369-373 manuscript received 7 Oct 80

SZENT-IVANYI, Tamas, Dr, KUCSERA, Gyorgy, Dr, TUBOLY, Sandor, Dr, BOGNAR, Karoly, Dr, KISS, Zsuzsanna, Dr, BERNATH, Sandor, Dr; Veterinary Medical University, Department of Epidemiology, and Institute of Animal Vaccine Control

[Abstract] To clarify practical observations concerning the immunosuppressive effect of VD vaccine, the results of comparative studies are reported. Cattle, in groups of six, were given A: 2ml VD vaccine, i.m. and 5 ml type A, monovalent HMD vaccine, s.c., simultaneously; B: 5ml HMD vaccine, s.c.; C: 2 ml VD vaccine, i.m. Blood samples were taken before and 7 times within 10 weeks after vaccination. Virus neutralization tests were run on the sera and various in vitro tests of lymphocytes obtained from peripheral blood were carried out. The simultaneous administration of the two vaccines did not lower the humoral immune response because the virus neutralization titers were similar in all three groups. The in vivo lymphocyte reactions include: stimulation test measured by autoradiography after ^{3}HTdR incorporation, immune rosette formation, immunofluorescence, inhibition of leukocyte migration and agar gel electrophoresis. Of these, there was no change in blastogenesis and migration inhibition among the three groups. However, during the first three weeks, there was a lowered immune rosette formation (6, 4 and 7 percent) with HMD antigen in the samples of animals receiving both vaccines and the ratio of IaG positive cells reached the level of the other two groups only after six weeks. Infection with virulent HMD virus, carried out on the 66th day, gave similar results in groups A and B. References 28: 8 Hungarian, 2 East German, 18 Western

2473
CSO: 2502/93

COST OF FREE ENERGY IN HUNGARY

Budapest ENERGIA ES ATOMTECHNIKA in Hungarian Vol 34 No 4 Apr 81 pp 153-157

KELLER, Peter, graduate mechanical engineer, Institute of Energy Management

[Abstract] Based on meteorological data collected over a 14-year period, calculations were made to determine the amount of utilizable solar energy over Hungary, considering the monthly average radiation intensities, the sunshine probabilities, and the conversion efficiency of the solar collectors used. The study was aimed at establishing the economic aspects of regional central hot-water heating, using Type NK-220 collectors developed by the ESZKV [expansion unknown] in Barcs. It was found that the amount of recovered energy increases when the required heating-water temperature is decreased; the inclination angle of the collector affects the amount of recoverable energy significantly only if it deviates more than 5 percent from the optimum angle; and the angle-sensitivity increases with increasing collector operating temperature. The concept of annual efficiency was introduced and the energetic and economic aspects of various heating plants were evaluated. The results were used to calculate the realizable savings of fuel oil having a calorific value of 42,000 kJ/kg, used in a boiler of 80 percent efficiency. The economic advantage of solar collectors increased significantly with decreasing heating-water temperature. An attempt was made to express the possible savings in financial terms based on oil-cost projections calculated by various formulas. Under current economic and technological conditions, savings from solar-energy use have a chance of being worthwhile only for applications such as supplying residential hot water and heating swimmingpool water, where the investment costs are much lower than for district residential heating. Figures 13, references 10; 7 Hungarian, 1 German, and 2 Western.

2542
CSO: 2502/97

AGRICULTURAL RESEARCH FOCUSING ON GENETIC ENGINEERING

Bucharest ERA SOCIALISTA in Romanian No 13, 5 Jul 81 pp 14-15

[Article by Academician Nichifor Ceapoiu: "Biology in Aid of the Agrarian Revolution," a report at the interdisciplinary discussion "Nature and Basic Aims of the New Agrarian Revolution in Romania. The Place and Role of Agriculture in the Socialist Economy" held on 19 June 1981 and organized by the Romanian Academy, the Academy of Social and Political Sciences, the Academy of Agricultural and Forestry Sciences and the Stefan Gheorghiu Academy jointly with the journals ERA SOCIALISTA and VIITORUL SOCIAL]

[Text] The main task of scientific research on agriculture today is to develop varieties and hybrids of agricultural plants with a high productive potential that will meet the requirements for use by agricultural technicians with a low energy input. This calls for use of two kinds of methods, namely conventional, traditional methods of plant improvement for the present stage and other, unconventional methods based on the latest advances in genetics, biochemistry, biophysics etc. for the following stages primarily.

The requirement for a major gain in agricultural production gives rise to a number of priority objectives of research on plant improvement. In connection with use of conventional improvement methods especially, I think these objectives are as follows, in order of their importance:

The first objective is to shorten the vegetation period of all agricultural plants in all ecologic areas of Romania, that of main-crop plants, and that of plants for successive crops under irrigation. Corn presents the most urgent problem because in general its harvesting is considerably rushed in fall.

The second objective is to improve the adaptability of the plants to agricultural mechanization, especially of harvesting operations. I refer to reducing the height of the plants and increasing their uniformity, strengthening their resistance to collapse and breakage, lowering and evening the height of attachment of corn cobs, increasing the uniformity of the cobs and the percentage of grains on them as well as the uniformity of sunflower blossoms, etc.

The third objective is to strengthen the resistance to disease of the various crops, especially those frequently damaged (kidney beans and sunflowers).

The fourth objective is to achieve a greater genetic and ecologic diversity and a more balanced structure of varieties in a crop, in order to prevent susceptibility to diseases and to make better use of the regional environmental conditions.

The fifth objective is to improve the quality of the agricultural products by modifying the chemical composition of the useful substances in the plants.

To be sure further production increases are still the main objective of research, but the chief obstacle to development of productive varieties is the contradiction between the productive capacity and the adaptability of the plants, making it difficult to combine productive properties with early ripening and resistance to frost or drought. Moreover, negative correlations are found between a high productive capacity of the plants and their content of useful substances (sugar or proteins). Yet recent results in plant improvement indicate that a number of these contradictions can be eliminated by using new sources of germ plasm, namely hereditary material.

Inadequate knowledge of the genetic determinism of the plants' quantitative characteristics is another difficulty. The current theories (theory of polygenic systems, theory of action of the pseudopolymeric genes, or theory of oligopolygenic systems) do not provide satisfactory explanations. But many difficult points have been clarified and it is to be expected that this problem will also be solved.

Implications of Genetic Engineering

In the last 2 or 3 years the Fundulea ICCPT /Research Institute for Grains and Technical Crops/ and some improvement centers at the research stations of the Academy of Agricultural and Forestry Sciences have developed and introduced a number of effective varieties and hybrids into production which are contributing to major gains in agricultural production. The Fundulea 29, Lovrin 32 and Bucovina 1 varieties of wheat were developed, with a productive potential of 7,000-9,000 kg per hectare. The 92, 94 and 98 hybrids of corn were developed, which are very early and suitable for successive cultivation and have a productive potential of 5,000-6,000 kg per hectare. And the recently developed corn hybrids like 180, 218, 350, 412 and 420 have a productive potential of 7,000-15,000 kg per hectare. The Sorem 80, Sorem 82 and Florom 305 sunflower hybrids are highly productive and have an oil content of 50-51 percent of dry substance. The new soybean varieties, Precoce 90 and Tomis, developed at the Fundulea ICCPT are much earlier than the varieties now in use and have a productive potential under irrigation of more than 4,000 kg per hectare. They are also rich in oil, proteins, lecithin and phosphatides.

But the question that arises in connection with the agrarian revolution is how far can we raise the productive capacity of cultivated plants by the conventional genetic methods?

Development of wheat varieties that will produce up to 10,000 kg per hectare, corn hybrids that will yield up to 18,000-20,000 kg per hectare, or sunflower hybrids that will produce up to 5,000 kg per hectare entails no difficulties that cannot be overcome by use of convential improvement methods.

But the difficulties will increase when we try to develop "superproductive forms" of cultivated plants that will yield 12,000-15,000 kg of wheat per hectare, 20,000-30,000 kg of corn per hectare, 6,000 kg of sunflowers or soybeans per hectare etc., which yields are to be obtained with minimal energy inputs.

Genetic engineering, one of the youngest branches of genetics, makes it possible to develop superproductive biologic forms with better properties of adaptability. In the true sense of the word, genetic engineering means the "technique of the recombinant DNA," in other words the technique of introducing segments of a gene or whole genes that determine certain properties or characteristics into bacteria or the cells of various plants and animals through the intermediary of such vectors as bacteriophages and plasmids.

In a broader sense, genetic engineering includes the whole system of cultures of cells, tissues and organs in addition to the technique of the recombinant DNA.

The cultures of cells and tissues unexpectedly contributued to in-depth knowledge of the v etal and animal cells, their omnipotence, the mechanism of cell division and dif tiation, the nutrition of the cell and the metabolism of the organism as a whole. Today we can produce any quantity of cells on the basis of a single cell, we can make clones of cells, and we can grow whole plants on the basis of fragments or parts of a plant or even of cells either by organogenesis or directly by embryogenesis in vitro.

A very important part in genetic engineering is played by the protoplasts obtained from the higher plants. By treatment with certain enzymes they can be reproduced, they can form their cellular membrane, and they can be divided to form haploid and diploid plants. But the most important point is that the protoplasts can merge and form the so-called "somatic hybrids" that are highly important for increasing agricultural production. Protoplasts belonging to taxons of a higher species can merge.

Somatic hybridization will permit transfer of genes of great economic importance from the remote forms to plants in order to create superproductive biologic forms. While sexed hybridization between species has rather limited possibilities because of the isolation mechanisms, there are no restrictions at all upon somatic hybridization. Species belonging to very remote taxonomic categories can be crossbred.

Biologic implanting of nitrogen in nonleguminous plants like wheat, barley, corn, sunflowers etc. is a very important field of application of genetic engineering and one that will revolutionize the technology of use of chemical fertilizers.

The most effective way to create the forms that implant nitrogen is to clone a certain region in chromosomes (the nif genetic region) that controls the synthesis of a particular enzyme (nitrogenesis) in the cells of cultivated plants. It became possible to transfer the nif genes from the host-bacteria to the cultivated plants when the technologies for cultivating the protoplasts and constructing the cloning vectors progressed.

Of course there are still many difficulties in organizing and conducting research on genetic engineering, but this is not the place to discuss them.

Long-Range Problems

There are many institutions engaged in genetic engineering in Romania. Some belong to the Academy of Agricultural and Forestry Sciences and others to the various ministries. The studies being made began a few years ago, actually in 1978, when a special program on this subject was drafted at the direction of the National Council for Science and Technology.

We can also point to some results obtained in this brief period. In the case of wheat, barley, corn, soybeans, sunflowers and cultivated vines cell cultures and suspensions were obtained that made it possible to produce somatic hybrods and protoplasts. In the case of potato plants, which are resistant to cultivation of cells and tissues, entire plants have been regenerated by cultivation of segments of the stalk in vitro. In flower cultivation (carnations, orchids, geraniums and chrysanthemums) and fruit growing (strawberries and fruit-bearing trees and shrubs) free forms of viroses were obtained.

In the field of biologic implanting of nitrogen, many cultures of Asospirillum and Beijerinkia were isolated that have the capacity to implant nitrogen in wheat, barley, corn and sunflowers. By use of the recombinant DNA technology vectors were obtained that can transfer genetic information to cultivated plants (vectors represented by the Ti bacterial plasmids). In the same field, particular genes (nif genes) have been transferred from the bacteria implanting nitrogen to some isolated strains of bacteria in the soil.

The results obtained in genetic engineering in Romania are promising though modest. Do not forget that in general the 1978-1980 period was one of personnel specialization, information and documentation, assimilation of working methods and techniques, and supply of equipment and chemicals.

We have effective research personnel inspired by the desire to obtain the most useful theoretical and practical results in this challenging and absorbing field. But the technical-material base of research must be improved, especially as regards procurement of chemical substances. They are hard to come by and expensive, and the same is true of the equipment in many cases.

The current research program meets the production requirements. But the program must be expanded and the research subjects better defined. Improvement of the research methods must be emphasized, as well as introduction of the new methods developed in other countries.

But one essential point must not be overlooked, namely that no newly developed variety or hybrid can yield its genetic potential unless it has optimal conditions for growth and development. On the contrary, the new varieties are much more demanding as to living conditions than the older varieties and especially the local ones, which are better adapted and less demanding but also less productive.

Accordingly the varieties and hybrids developed by the genetic engineering method cannot develop their high productive capacity and become truly superproductive organisms unless all requirements of the respective cultivation technologies are observed. Proper treatment of the soil, application of fertilizers in the prescribed quantities, observance of crop rotations, control of diseases, pests and weeds, punctual and proper harvesting, and optimal preservation of harvests are basic if the new creations are to produce high yields of better quality.

The highly productive forms of plants developed by genetic engineering call for new organizational measures and investments in Romania's agriculture. They will be fully rewarded by the excellent productive properties of these new cultivated plants.

In view of the results so far and the long-range prospects they open up, we are convinced that research on genetic engineering will enter into a more rapid and more constructive phase in Romania, producing the results which are expected in production and which will truly revolutionise agriculture.

5186
CSO: 2702/29

UDC 62-531.001.3

REVIEW OF MICROPROCESSOR CONTROL OF MANIPULATOR ROBOTS

Zagreb AUTOMATIKA in Serbo-Croatian No 5-6, 1980 pp 281-286

[Article by M. Kircanski and O. Dzigurski, Mihailo Pupin Institute, Belgrade; submitted 18 February 1980]

[Excerpts] Table 1 presents a survey of the most important characteristics of several types of manipulators that are commercially available today. The table shows only industrial robots in which digital computers are used for control and for processing the sensor signals, though a large number of commercially available manipulators use encoder matrices and conventional digital control modules.

The conclusion can be drawn from the table that a majority of the manipulators possess 3 ... 6 degrees of freedom, the load weight goes up to a few tens of kilograms, and the maximum speed is about 1 ... 2 m/sec. Electromechanical and hydraulic actuators are used, except that pneumatic drive is usually used for the pickup. The table also gives positioning accuracy during cyclical repetition of the functional movement (this accuracy is determined mainly by the electromechanical tolerances of the system), and it also depends on the manipulator's maximum load weight and ranges from ±0.1 mm to ±2 mm.

The UMS-1 and UMS-2 General-Purpose Industrial Manipulation Systems

The UMS-1 industrial manipulatory system represents Yugoslavia's first industrial manipulator. It was developed through cooperation between the Mihailo Pupin Institute and the Zemun factory Teleoptik. In order to test the characteristics of this system in differing patterns of operation, before the system was built numerous simulations of the manipulator's movements were run on a digital computer by means of a dynamic model of the manipulator [9, 10].

The manipulator's configuration is represented by a minimal configuration of the anthropomorphic type (Figure 3) with three active rotational degrees of freedom and one passive degree of freedom of the pickup [8]. The anthropomorphic configuration has the advantage over other configurations that the manipulator can be applied directly without any sort of adaptation of the work station.

The UMS-1 manipulator system encompasses two subsystems: mechanical and electrical. The electrical subsystem is made up of a digital computer containing

the control algorithm and the operative elements: DC motors with appropriate analog servosystems. The digital computer was designed around the Intel 8080 8-bit microprocessor. Programs which generate signals that control the manipulator's movements during performance of the work task and in the learning process are stored in this computer's permanent memory. Learning takes place under the real and dynamic conditions of the manipulator's movements, and the results of learning are used to correct the trajectory when disturbances are affecting the system. During performance of the work task three phases of movement are distinguished as the top of the manipulator moves between the two end points: starting, acceleration and deceleration. A detailed description of the manipulator's control algorithm is given in [4 and 5].

Table 1

Manipulator Model	No of Degrees of Freedom	Max Load Weight	Max Speed	Positioning Accuracy	Type of Activator	Control System	Approximate Price in $
UNIMATE 2000 CONNECTICUT-USA	6	56kg	—	±1.27mm	H+P	microcomputer (1)	50000-60000
PUMA CONNECTICUT-USA	5	2.4kg	1 m/s	±0.1mm	E+P	microcomputer LSI-11	40000
MILACRON-T3 OHIO-USA	6	136kg	1.27 m/s	±1.27mm	E+H	minicomputer (2)	110000
MIT STANFORD-USA	5	1.5kg	—	±1mm	DC servo with brakes (3)	microcomputer	—
IVO-ARM 6000 CONNECTICUT-USA	6	35kg	1.5 m/s	—	E or H	minicomputer	—
VERSATRAN E-300 VIRGINIA-USA	3	M = (4) 800 lbin	60 m/s	±1.27mm	E+H	microcomputer	—
BINKS Illinois-USA	5	27kg	1.7 m/s	—	H	16-BIT microcomputer	—
ASEA IRb-6/60 SWEDEN	6	6(60)	1.1 m/s	±0.2(0.4)mm	DC+P	8-BIT microcomputer	50000
SIROBOT-1 Siemens-W. Ger.	6	20kg	1 m/s	±1mm	DC	microcomputer	40000
EW-500-1 JAPAN	6	—	—	±1mm	E	microcomputer	—
UM-1 USSR	3	40kg	—	±2mm	H	programmatory system with bus tracking (5)	—
UMS-1 Yugoslavia	3	0.5kg	0.5 m/s	±1mm	DC	8-BIT microcomputer	20000
UMS-3 Yugoslavia	6	2kg	1 m/s	±1mm	DC	8-BIT microcomputer	30000

Key:
1. Microcomputer
2. Minicomputer
3. DC servo with brakes
4. M = 800 lb in
5. Encoder system with punched tape

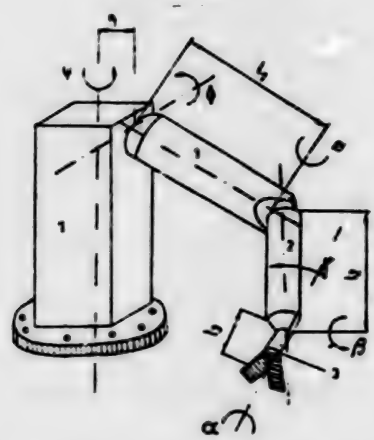

Figure 3. UMS-1 industrial manipulator.

The microcomputer which controls the system also possesses a large number of output registers, which are used to control the pickup, to synchronize the operation of the manipulator and other systems in the work space (for example, of presses and the like), and so on. The UMS-1 industrial manipulator system is furnished with tactile sensors on the inner side of the pickup, which makes it possible to monitor the correctness with which the manipulator system is operating.

The UMS-2 general-purpose manipulator system is the second of the series of lightweight industrial manipulators, and once again it was designed in the Mihailo Pupin Institute in Belgrade [11, 12]. The manipulator possesses three degrees of freedom in its basic configuration (one rotation and two translations), and three degrees of freedom of the pickup (three rotations) (see Figure 4). DC electric motors are the actuators of all the degrees of freedom.

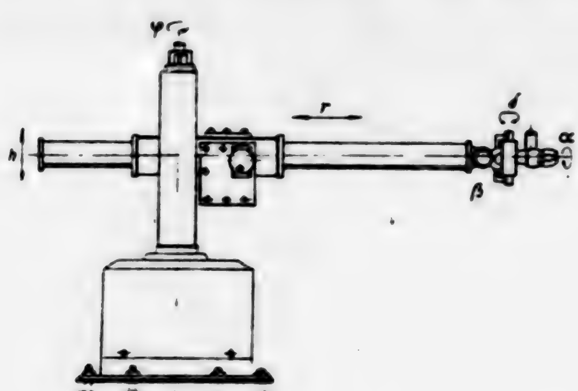

Figure 4. UMS-2 general-purpose manipulator system.

The manipulator's control system uses an 8-bit microcomputer* and an analog position-speed servosystem. The configuration of the microcomputer consists of a

* DARTA-80, a microcomputer developed in the Jozef Stefan Institute in Ljubljana.

RAM [(?) random access memory] memory with a minimum capacity of 1 k x 8 bits, which can be expanded with modules of 4 k, an EPROM [(?) electronic processor memory] memory, also in modules of 4 k x 8 bits, 40 digital input and output channels, interface for video display or teleprinter, and provision has also been made for connection to digital cassette or floppy disk.

The work task is programmed simply by giving commands through the video display. The programming process is made still easier by the manipulator's configuration, which corresponds to the cylindrical coordinate system.

In view of the weak coupling that exists between the various degrees of freedom, a separate servosystem has been designed independently for each actuator. This manipulator's servosystems are based on pulse width modulation and ensure a broad range of linearity.

The control part of the UMS-2 system also provides for the processing of signals from sensors of various types, from the simplest sensors that generate 1-bit pieces of information all the way to the more complicated types of sensors (sensors of force, ultrasonic sensors, surface tactile sensors, and so on).

3. Lines of Development of Industrial Manipulator Systems

The requirements which are imposed on industrial manipulators are today numerous and complicated. These are, first of all, the requirements of achieving maximum independence in the operation of the manipulator, the requirements for increased versatility of manipulator systems, and the requirements for higher speed and positional accuracy.

It is very important to reduce the need for human intervention in the operation of the manipulator system. It, first of all, makes it necessary to use a maximum number of sensors in the feedback circuits of the control systems, but it also embodies a demand for higher reliability and operating accuracy of the manipulator system. The capabilities of industrial manipulators can be expanded considerably if a sensor-interactive computer is introduced into the control system. This makes it possible to achieve adaptivity of the manipulator system. Adaptivity is the manipulator's ability to correctly perform its work task even when changes occur in its work space. If the manipulator is to be adaptive, the control system must be constantly monitoring the condition of the environment and the state of the manipulator system, that is, it must be equipped with a sufficient number of sensors furnishing the data for making decisions on its further operation [2].

Sensors which can be put to very worthwhile use in a manipulator-pickup system might be these:

1) Sensors of position, speed and acceleration.

2) Sensors of force with several degrees of freedom for measuring forces and moments affecting the system from outside.

3) Sensors of force on the pickup to monitor grasping force.

4) Optical sensors for analyzing the work space.

5) Surface tactile sensors to determine the shape of the pickup's area of contact and of the workpiece and detection of slippage of the workpiece.

6) Ultrasonic sensors to measure the distance to some obstacle or to the workpiece.

7) Safety sensors to detect the possibility of an imminent collision between the pickup and an obstacle.

8) A "whisker" sensor to study the pickup's contact with surrounding objects.

Figure 5 shows the pickup of a manipulator system with one of the possible arrangements of the types of sensors which have been mentioned.

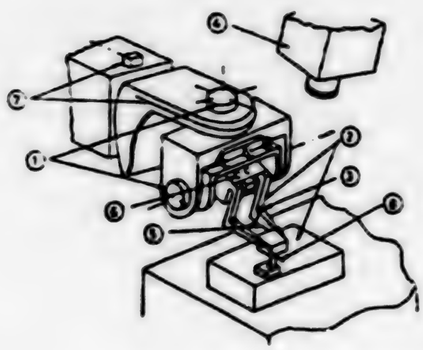

Figure 5. System of sensors on the manipulator's pickup.

Use of a complex sensor-interactive control system is also an elegant way of solving one of the most common problems in industrial manipulation--the problem of feeding workpieces, which up to now has been solved either by mechanical systems or by means of a human operator. It is now possible for the piece to be picked up from a moving belt, which is making it easier to apply robots in industrial practice.

However, the sensor-interactive manipulator system requires a very large computer effort, so that up until recently sensor-interactive manipulator systems were built only with minicomputers with a rapid processor and a very complicated operational system. Manipulator systems with such computers carry a very high price. Today, however, it is possible to replace the minicomputer with a set of microcomputers linked up in multiprocessor operation [1]. In such a system the individual microcomputers would have the task of processing signals from one or more sensors for monitoring the servosystems of particular joints, while one main microcomputer would coordinate the operation of the entire system. Each microcomputer is programmed entirely independently, since the hardware ensures that only one microcomputer has access to the common memory at any particular

time. Thus the complicated operational system and speed of the minicomputer are replaced by the parallel operation of several microprocessors, and the price of such systems is considerably lower. A system of this type is illustrated by the block diagram given in Figure 6.

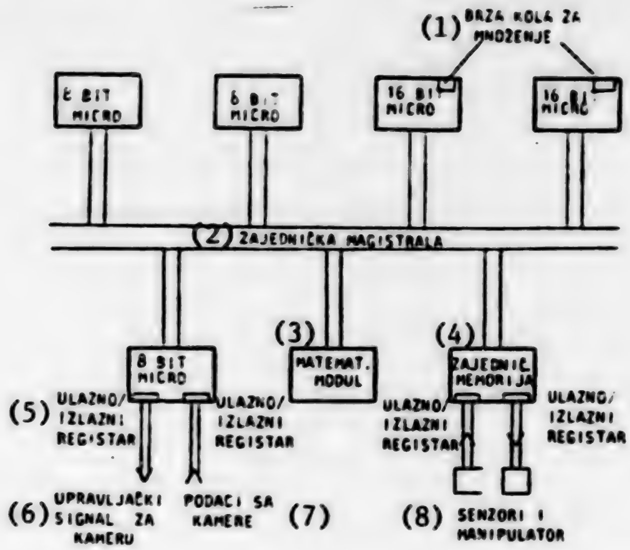

Figure 6. Example of the configuration of a multiprocessor system.

Key:
1. Fast multiplication circuit
2. Joint line
3. Mathematical module
4. Common memory
5. Input and output register
6. Control signal for the camera
7. Data from the camera
8. Sensors and manipulator

Another demand which is imposed on today's industrial manipulators, the demand for achievement of maximum versatility of manipulator systems, is manifested in the need for simple and rapid reprogramming of the robot to perform new work tasks. Specialized and higher program languages for the description of work tasks which can also be used in one of the microcomputers in the multiprocessor system are offering large opportunities in this respect.

Higher speed and accuracy of operation of industrial manipulators is also an essential precondition for maximum effectiveness in use of manipulator systems in industrial practice. One of the algorithms that would certainly increase the manipulator's speed of movement and increase its accuracy is the use of dynamic control.

Possibility of Implementing Dynamic Control on a Microcomputer

Kinematic control of manipulators, which means that the desired trajectories of the internal angles of the various degrees of freedom are generated at the analog outputs of the microcomputers, has been used in most of the control systems based on the microcomputer to date. These signals are then led to the inputs of the respective robot servosystems through which the desired positional accuracy

is attained at the cost of large amplification. But dynamic control of manipulators is proposed, however, to increase the speed of operation of the manipulator and positional accuracy without unnecessary reserve power on the part of the actuator [6]. Two-stage synthesis of the control system is adopted in dynamic control [7]. In the first stage it is necessary to synthesize the kind of control that would ensure movement of the system along the desired trajectories when the system is not affected by disturbances of any kind. In the second stage there is a need to provide for satisfactory monitoring of the given trajectories even in the case of disturbances to the system.

This concept of control can be achieved with microcomputers only if high-performance microcomputers are used with a high-speed "floating point" processor and a sophisticated operational system.

The functions with the microcomputer is to perform in the first stage, the stage of synthesis of nominal control operations, are the following: a) to determine the generalized internal angles of the manipulator on the basis of the given positions of the top of the manipulator and the orientation of the pickup along the nominal trajectory (this requires determining the Jacobian transformation of external angles to internal angles and its inversion), b) to determine the generalized drive moments in the joints, that is, the nominal control instructions at the inputs of the actuators. The procedure for synthesizing the nominal control instructions of the microcomputer should be performed in the learning process, and a sequence of nominal program control instructions should be formed as a result of that procedure.

In the second stage, during performance of the work task, there is a need for the microcomputer to generalize program control instructions and to furnish feedback connections in order to ensure satisfactory monitoring of the nominal trajectories. The feedback signals on position, speed, moments and forces in the joints should be measured and processed in the microcomputer and then converted to the appropriate analog signal and sent to the servosystem. Dynamic control of the manipulator cannot at present be achieved in real time on the microcomputer, but possibilities exist for developing somewhat simpler dynamic models which would be used as the basis for control algorithms that would result in higher speed and positional accuracy.

For the sake of performance of all these functions on the microcomputer it is convenient that the microcomputer have "floating point" arithmetic instructions, the possibility of programming in some higher program language (PL/M, BASIC or FORTRAN, and so on), a library of programs with trigonometric functions, operation with matrices, and so on.

4. Conclusion

The strong development of microprocessors over the last several years has brought about a qualitative leap in the capabilities of control systems of industrial manipulators. The emergence of the new 16-bit microcomputers, which are software-compatible with their 8-bit predecessors, will result in a still faster development of industrial manipulator systems. Their use will afford the

following possibilities at a relatively low cost: a) dynamic control of manipulators on the basis of complex control algorithms (up to now control was based mainly on a kinematic model of the manipulator), b) processing of signals from sensors, including the most complicated types of sensors (TV cameras), c) introduction of higher specialized program languages for interactive communication with the system, and so on. Although many of these possibilities have already been achieved in development laboratories, the new 16-bit processors will make it possible to implement these functions even on commercially available industrial manipulators. The further development of industrial manipulators will result in a further price drop, higher speed and positional accuracy, and greater reliability, versatility and adaptability of industrial manipulators.

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